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FOR

PLANT CONTAINER AND SIDEWALL PROVIDING IMPROVED MANAGEMENT OF IRRIGATION AND AERATION

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PLANT CONTAINER AND SIDEWALL PROVIDING IMPROVED MANAGEMENT OF IRRIGATION AND AERATION

This application is a continuation of pending U.S. Application No. 10/075,096, filed on October 29, 2001.

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] This invention relates generally to plant containers and root growth barriers, such as for use with landscape plants such as trees and shrubs prior to transplanting.

Background of the Related Art

[0002] Transplantable plants for use in landscaping, such as trees and shrubs, are generally initially grown in conventional smooth-walled containers made of plastic, steel or other materials. However, when a root contacts the inner sidewall of a smooth walled container the root is deflected and follows the curvature of the container. The result is the production of only a few secondary branch roots. In some cases, roots make several revolutions around the container, mostly at the bottom, forming a coil. The result is an abnormal root system that does a poor job of establishing and supporting the plant following transplanting. Impaired root development following transplanting restricts growth of any species. Poor root development and anchorage is especially detrimental to trees that grow to considerable height and where stresses from wind, ice and snow are exaggerated.

[0003] Whitcomb (U.S. Patent Nos. 4,442,628; 4,510,712; 4,753,037; 4,939,865; and 5,557,886) teaches various sidewall designs with strategic placement of openings in above ground containers to accomplish air-root-pruning (root tip dehydration pruning) to stop root circling and stimulate root branching. These containers work by guiding an actively growing root tip, which is white soft tissue, into an opening where the root tip dehydrates, dies and is,

therefore, effectively pruned. The effect on the root system is the same as when a plant is pruned above ground, for example, to make a hedge. Each time the plant is pruned above ground, secondary branches form back as far as about four inches from the point of pruning and through a succession of prunings, a dense plant hedge or screen can be created. An identical phenomenon is seen to occur with roots for the same physiological reasons. Such air-pruning container designs have been successful and are currently sold in various sizes (available under the Rootmaker™ and RootBuilder™ trademarks from RootMaker Products Co., LLC of Huntsville, Alabama).

[0004] Van Wingerden (5,131,185), Lawton (5,099,607) and Henry (5,241,784) also teach air-root-pruning by container sidewall design. Butler (5,937,577) teaches air-root-pruning as a result of constructing a container out of chicken wire and lining the inside with a woven polyester fabric. Butler (5,937,577) does accomplish air-root-pruning throughout the circumference of the container, but the salt accumulation due to the high loss of water to evaporation makes it less efficient in terms of conserving water. This design is generally only practical to use where irrigation water quality is good and humidity is high.

[0005] Whitcomb (4,497,132) teaches that when root tips are trapped in a saw tooth-like recess as part of the container wall and cannot extend, root tips cease to grow and root branching results. Root circling is reduced and root branching is improved. However, despite the improvements shown by Whitcomb '132, some spiral root growth is still seen to occur because there are limited number of root-tip-trapping points, and the growth of lateral roots and development of the lateral root tips is not optimal. Once roots occupy all of the root-tip-trapping recesses, as in the '132 container, additional roots may circle and branch poorly in much the same manner as in a conventional container.

[0006] Reiger (5,768,825) discloses the use of a monolayer of fabric sewn into the shape of a plant preservation and growth control bag. A porous fabric is employed, which restricts the growth of a plant preparatory to transplantation, by catching the roots in the recesses of the fabric. This permits fewer roots to emerge from a layer of fabric, but those that do are prevented from developing further by "girdling" or constriction pruning as a result of fabric entanglement.

However, this method is restricted for use during the short time when plants are to be preserved for transplantation and is not suitable for longer-term growth and maintenance. Removal of fabric from plants placed in this system more than a few months is nearly impossible as roots grow through the fabric and develop on the opposite side. Optimal root growth is not maintained because the roots must be broken off at the inside face of the fabric or in the fabric when the fabric is removed. Further, the invention of Reiger ('825) must be used inside a conventional container or in the soil to avoid severe water loss due to evaporation through the fabric.

[0007] Therefore, a need exists for a root growth barrier or container for the purposes of encouraging healthy and abundant root growth and permitting optimal development and growth of lateral roots and root tips. It would be desirable if the barrier could provide improved management of water and oxygen within the container. It would also be desirable if the barrier could provide a much greater number of pruning elements, such as root-tip-trapping elements and air-root-pruning elements.

SUMMARY OF THE INVENTION

[0008] The present invention provides a sidewall for a plant container and a plant container incorporating the sidewall. The sidewall comprises a root-tip-trapping region, such as a bilayer material described below, and an air-root-pruning region, wherein the regions are combined to form the sidewall. The root-tip-trapping and air-root-pruning regions may be configured in various patterns such as rows, columns, dots, checkerboard and the like. However, the most preferred configuration has the root-tip-trapping region forming a continuous upper portion of the sidewall and the air-root-pruning region forming a lower portion of the sidewall. Preferably, the root-tip-trapping region will form the upper half of the container. Most preferably, the root-tip-trapping region will form between 2/3 and 3/4 of the sidewall.

[0009] The root-tip-trapping region is preferably formed by two layers bonded to one another to form a bilayer material. The bilayer material includes a root-tip-trapping layer that prevents the root tips from circling and a layer consisting of a root-impenetrable material formed onto a surface of the root-tip-trapping layer to prevent further advancement of the root tips. The root-

tip-trapping layer is preferably a fabric, such as a spun bonded and needle punched fabric, a woven fabric, or a knitted fabric. The root-impenetrable material is preferably a polymer film, such as polyethylene, that is bonded to the root-tip-trapping layer. The root-impenetrable layer is preferably also water-impenetrable or water-impermeable.

[0010] The air-root-pruning region is preferably formed with the same type of material as the root-tip-trapping layer of the root-tip-trapping region. Accordingly, the air-root-pruning material is preferably a fabric, such as a spun bonded and needle punched fabric, a woven fabric, or a knitted fabric.

[0011] The present sidewall is preferably used to form a freestanding plant container, for example a container with vertical sides and a flat bottom. Alternatively, the sidewall or the container may be placed in other pots or containers, or in open soil. The barrier may also be comprised of biodegradable materials for use in the root-tip-trapping layer, the root-impenetrable layer, or both layers.

[0012] A method of using the sidewall or container to grow a plant is also provided. The method may be employed with rolls of the sidewall material. The method comprises the steps of disposing a layer of the sidewall material adjacent to a growth medium and providing a plant in the medium. The method may also be adapted to grow the plant in-ground, wherein the method comprises the steps of placing growth medium in a container including the sidewall material, disposing the container in soil, and adding a plant in the growth medium.

[0013] Other objects, features and advantages of the present invention will be apparent from the following detailed description when read in conjunction with the drawings and appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] So that the above recited features and advantages of the present invention can be understood in detail, a more particular description of the invention, briefly summarized above,

may be had by reference to the embodiments thereof that are illustrated in the appended drawings. It is to be noted, however, that the appended drawings illustrate only typical embodiments of this invention and are therefore not to be considered limiting of its scope, for the invention may admit to other equally effective embodiments.

[0015] Figure **1** is a perspective view of a container formed from the root growth barrier of the present invention with a tree growing therein.

[0016] Figure **2** is a cross-sectional side view of the container shown in Figure **1**.

[0017] Figure **3** is a partial cross-sectional view of the root growth barrier shown in Figure **2**.

[0018] Figure **4** is a partial perspective view of a root growth barrier having a knit-type fabric layer providing a high-density of discrete root-tip-trapping elements.

[0019] Figure **5** is a partial cross-sectional view of a prior art air root pruning container.

[0020] Figure **6** is a partial cross-sectional view of the root growth barrier of Figure **3** illustrating how root tips enter into the root-tip-trapping layer, impinge upon the root-impenetrable layer, become trapped, and experience enhanced root branching.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0021] One embodiment of the present invention provides a sidewall for a plant container and a plant container incorporating the sidewall. The sidewall comprises a first region that is nonporous or water-impermeable and a second region that is porous or water-permeable. Preferably, the first region of the sidewall comprises a nonporous root-tip-trapping region, such as the bilayer material described above, and the second region comprises a porous air-root-pruning region, wherein the first and second regions are combined to form the sidewall. The root-tip-trapping and air-root-pruning regions may be configured in various patterns such as rows, columns, dots, checkerboard and the like. However, the most preferred configuration has

the root-tip-trapping region forming a continuous upper portion of the sidewall and the air-root-pruning region forming the lower portion of the sidewall. Preferably, the root-tip-trapping region will form between 1/2 and 9/10 of the sidewall, most preferably between 2/3 and 3/4 of the sidewall.

[0022] A particularly preferred sidewall comprises a layer of porous fabric and a layer of water impermeable, root-impenetrable material disposed over only a portion of the outer face of the fabric layer. The water-impermeable, root-impenetrable layer may be disposed over the porous fabric layer in any configuration and over any portion as described above, but is preferably formed over the upper half to 9/10 of the porous fabric layer. In the manner described, a single sheet of the water permeable, porous fabric may provide both the porous region of the sidewall and the inner layer of the bilayer material of the nonporous region of the sidewall.

[0023] It should be recognized that the root-tip-trapping region(s) and the air-root-pruning region(s) of the sidewall or container formed therefrom may be made from materials that are flexible, rigid, or a combination thereof. One example of flexible materials is provided by the composite fabric sidewall describe herein and in U.S. patent application serial number 10/075,096, filed by the present inventor on October 29, 2001, which patent is incorporated by reference herein. Another example of a suitable material that is also flexible is found in U.S. Patent 4,939,865, incorporated by reference herein, and the copending U.S. patent application 10/446,987 filed by the present inventor on May 27, 2003, also incorporated by reference herein. The latter two references describe bendable sheets having protuberances for air-root pruning and the sheets are sufficiently flexible to be bent and secured into a cylindrical shape for use as a container sidewall. In accordance with the present embodiment of the invention, a portion of the protuberances may have the outwardly extending distal end closed to form a root-tip-trapping region in combination with a region of open-ended air-root-pruning protuberances. Furthermore, the root-tip-trapping region could be formed with or without the protuberances by bonding a suitable porous fabric material to the inside surface of the sheet. It should also be recognized that these and similar configurations could be made rigid by increasing the thickness of the polymer material, changing the material of construction, or providing reinforcement.

[0024] The sidewall materials disclosed herein may be formed as ready-made containers, or as sheets for assembly into containers in the field. Where the sidewalls of the present invention are made with fabrics or thin ply sheets, a container may be formed by fastening one or more sidewall sections or panels together, for example by sewing, gluing, plastic welding, bonding, and the like.

[0025] Regardless of how the sidewalls or containers are constructed, the porous region is preferably disposed along the lower edge of the sidewall in order to improve water drainage from the container. Poor drainage can cause a water table that is 'perched' above the bottom of the container, holding excess water and blocking oxygen to the roots. Having a water permeable region along the lower edge of the sidewall not only reduces the water table, but also allows air-root-pruning to occur. After rain or irrigation has stopped, water will continue to exit slowly through the water permeable region until the pressure of the water in the upper part of the container no longer puts sufficient pressure on water at the bottom to overcome adhesive and cohesive forces that hold water in. The growth medium in the upper portion of the container is initially moist but also well-aerated, because air is sucked into the upper portion of the medium as water exits the growth medium in the lower portion of the container. Over time, evaporation of water from the exposed upper surface of the growth medium, as well as the use of water by plants, causes the upper portion of growth medium to dry and water from the lower portion to be wicked upward. The water impermeable layer in the root-tip-trapping region of the sidewall reduces water loss from the upper region of the growth medium. The water permeable, porous fabric forming the air-root-pruning region of the sidewall allows drainage of any excess water during and immediately following irrigation, then allows for air uptake into the growth medium during evaporation and use of the water from the growth medium. The present sidewall and container provides these water and oxygen management advantages in combination with the advantages of a root-pruning container.

[0026] By adjusting the container's ratio of the surface area of water permeable material to the surface area of water impermeable material it is possible to obtain an appropriate balance of water drainage and oxygen concentration, on the one hand, and water retention, on the other hand. Because certain species of plants are more sensitive to low oxygen and excess water, such

as pine tree species and related conifers and a few deciduous plants such as flowering dogwoods and redbuds, the use of the water permeable material in the sidewall greatly improves the conditions for growing these plants. It is believed that the conditions caused by the sidewall will also improve the growth of many other plant species as well.

[0027] One embodiment of the invention has a root-tip-trapping region provided by a porous fabric layer and a root-impenetrable layer bonded together. Most preferably, the root-impenetrable layer is also water-impermeable. Multiple porous fabric and root-impenetrable layers are also envisioned. The bonding may be accomplished in a variety of ways, such as lamination or by means of an adhesive.

[0028] The advantages of the present sidewall and container include increasing root branching, eliminating root circling, decreasing the amount of water needed, improving aeration, reducing root zone soil temperature, improving transplantation of plants to another medium, and generally improving the health and accelerating the growth of the plants. Plants may be grown in said containers for a time period ranging from a few months to several years and ranging from a small size to a very large size. It is an important aspect of this invention that the sidewall and container combine root-tip-trapping and air root pruning to achieve improved conditions for root growth.

[0029] The layer or layers of porous fabric forming part of the root-tip-trapping region may be any fabric that, when bonded to a layer of a root-impenetrable material on one side surface (i.e. face-to-face), will provide the bilayer composite with the capacity to trap an actively growing root tip between the fabric's fibers (within the fabric's openings) and against the root-impenetrable material. The fabric fibers need only be thick enough so as to trap the root tip against the root-impenetrable material to stop further root extension. The fibers may be free, looped, knitted, woven or spun bonded so long as the fibers do not deform or stretch when a root pushes against it and provides for high numbers of root tips to become trapped in the openings on the fabric surface. Even degradable fabrics such as cotton may be used, when the period of root control need only be brief (i.e. confined to one or two months). The degradability of the fabric is especially advantageous in situations where root growth need only be optimized during a short critical period. While the fabric may be made from various materials, the fabric is

preferably a polymer such as polypropylene, polyester, nylon, or other olefin. Preferably, a spun bonded needle punched fabric may be used. Preferably, the fabric has a weight ranging from 1 to 10 ounces per square yard, and more preferably ranging from 4 to 6 ounces per square yard. To shield the soil or other growth medium from the effects of light and UV radiation, the root-tip-trapping material is preferably a dark color, most preferably black. It is also preferable for the fabric to have openings of less than ¼ inch, depending on the plants to be grown adjacent the barrier. For stimulating the root growth of woody dicotyledons, such as willow and oak trees, the openings preferably have a diameter of between 1/16 inch and ¼ inch. Openings with a diameter smaller than 1/16 of an inch are well-suited for use with herbaceous dicotyledons such as tomatoes and petunias. A similar description of this material and its uses is found in U.S. patent application serial number 10/075,096, filed by the present inventor on October 29, 2001, which patent is incorporated by reference herein.

[0030] The root-impenetrable material may be any material that does not permit root penetration, such as films, dense fabrics, aluminum or other metal foil, and plastic sheets. Preferably, the root-impenetrable material is also water-impermeable to prevent water loss therethrough. The root-impenetrable layer may also be formed by any composition, including polymers, inorganics, and composites, with polymers being the most preferred. Polymers such as vinyl, or polyolefins such as polyethylene, polypropylene, polyisobutene, poly but-1-ene, and poly 4-methyl-pent-1-ene may be used. Preferably, the root-impenetrable layer has a reflective and light colored coating or surface. Most recommended is a white polyethylene layer coating or surface.

[0031] The composition of the root-impenetrable material may also comprise additives. For example, where the root-impenetrable material is a polymer, the polymer will preferably include UV inhibitors to provide high UV stability. In a most preferred embodiment, the root-impenetrable material forming the outer layer of a bilayer root growth barrier comprises white polyethylene having a thickness of 2-6 mils and with UV inhibitors for stability. Additionally, the root-impenetrable material may be rigid or flexible and have any desired thickness, including as thick as 2-6 mils, more preferably 3-5 mils.

[0032] As mentioned, bonding layers of the root-impenetrable material and the porous fabric may be accomplished by various means, including lamination or using an adhesive. For example, an outer white polyethylene layer may be glued to an inner fabric layer that is either spun bonded and needle punched or a woven or knitted fabric. Any glue may be used, provided it is water-insoluble. Furthermore, any lamination techniques may be used, provided that the lamination temperature employed does not melt or otherwise damage the porous fabric layer. Alternatively, one of the layers may be formed directly onto the other layer, such as the root-impenetrable material being sprayed or poured over the root-tip-trapping layer.

[0033] In an alternative embodiment, it may also be possible to stretch-wrap or shrink-wrap a water conserving and root-impenetrable layer to the fabric layer. However, the use of these layers must generally be applied over the fabric layer of a container after the container has been filled with growth medium so that the stretch-wrap or shrink-wrap may be placed in tension against the fabric without deforming or collapsing the container. While bonding of the layers is preferred, these wrapped layers will still provide substantial water conserving and root trapping benefits to a container that would otherwise comprise only an air-root-pruning fabric. For example, the wrapped layer will prevent evaporative losses, described earlier. Accordingly, the wrapped layer is preferably positioned over the upper region of the container sidewall in the same manner as described earlier with respect to the root-tip-trapping region. Optionally, the wrapped layer may be applied around the fabric layer following a period of plant growth when the water needs of the plant are greater. Similarly, while the entire sidewall and/or bottom could potentially be wrapped, it is preferred to leave the lower 1/10 to ½ of the sidewall unwrapped to allow water drainage and aeration as previously described with respect to the air-root-trapping region. Furthermore, the wrapped layer may provide some degree of root-tip-trapping. However, since the wrapped outer layer is not bonded to the fabric layer, it is preferable for the wrap to have sufficient strength to minimize the number of roots that would either penetrate the wrap or squeeze between the fabric layer and the wrap layer and begin to circle. Examples of suitable wrap materials include low density polyethylene, polypropylene, polybutylene, and polyvinylchloride.

[0034] The sidewall may be used to form containers wherein plants may be placed and grown for shorter or longer periods of time. The containers may have any shape or size. In a preferred embodiment of the invention, the container is cylindrical in shape. This is particularly advantageous in that it provides vertical sides and a flat bottom portion to the container, having close contact with the ground. This contact keeps the root zone of the plant cooler in the summer and warmer in the winter because of increased heat transfer with the ground. The containers are preferably assembled by stapling or sewing along the edges of the sidewall, such as with a conventional sewing machine or a surger-type sewing machine.

[0035] The sidewall materials may be used to make containers of various sizes for use in growing various types of plants. The size or volume of the container may be enlarged for use in growing larger plants, or plants at a later state of development. For example, a container for a woody plant may be provided, with a diameter of 5 inches and a capacity of 1 gallon, a diameter of 18 inches and a capacity of 15 gallons, or a diameter of 72 inches and a capacity of 250 gallons or higher. Similarly, a smaller container may be provided for use in growing herbaceous dicotyledons, such as tomatoes or woody monocotyledons, such as palm trees. Optionally, handles may be cut into the tops of the container to permit grasping with the hand for ease of transport.

[0036] The present invention further provides methods of using the sidewalls in horticulture and recreational gardening. Rolls of the sidewall material, suitable for lining plant pots and other containers, may be produced. The sidewall may be used above ground by cutting strips of the bilayer and forming them into a lateral barrier lining the interior of a pot. For inhibition of roots growing in a basilar direction, a piece may be cut from the roll to line the bottom of the pot. However, in order for the sidewall to function optimally, it is necessary for the pot to have drain holes and it is beneficial for the drain holes to be very large to expose as much of the porous region of the sidewall as possible.

[0037] It should be apparent that the unique sidewall construction of the invention offers many advantages over existing systems or containers for preventing root circling and abnormal or weakened root growth, while promoting water conservation that minimizes any perched water

table and provides proper aeration. Furthermore, because the various embodiments of the root growth barrier provide greater irrigation efficiency, aeration and cooler soil temperatures than do conventional plastic containers, the container promotes plants that are healthier overall and grow faster, whether the plants are ultimately transplanted or maintained permanently in the container.

[0038] Referring now to Figure **1**, a side elevational view of a container **10** of the invention with a tree **11** growing therein is illustrated. The container **10** has a sidewall **17** comprising a root-tip-trapping region **13** and a porous fabric region **20**. The root-tip-trapping region **13** includes an inner layer of porous fabric **18** and an outer layer of a nonporous, root-impenetrable material **16**. The nonporous, root-impenetrable material **16** is preferably white polyethylene to allow for greater reflectivity, light weight and strength, and results in a cooler container and soil temperatures as well as water conservation gains. The porous fabric **18** is preferably a dark colored spun bonded fabric that cooperates with the root-impenetrable layer, discussed above, to guide root tips to the outside to be air-root-pruned which stimulates root branching and prevents algal growth in the container. In the embodiment shown, the same porous fabric **18** forms the porous region **20**. The container **10** is shown having a vertical seam **14** and a bottom perimeter seam **19** that may each be formed by sewing, stapling, or any other method of fastening the edges of the material.

[0039] Figure **2** is a cross-sectional side view of the container **10** shown in Figure **1**, showing the construction of the sidewall **17** in greater detail. In the root-tip-trapping region **13**, the root-impenetrable material **16** is laminated together with the porous fabric **18**, which may be any fabric that would trap roots as they grow into the fabric layer. Seams **19** are shown coupling a floor or bottom **15** to the sidewalls **17** of the barrier to form the container **10**. The bottom **15** is preferably a bilayer material like that used in the root-tip-trapping region **13**.

[0040] Figure **3** is a partial cross-sectional view of the root-tip-trapping region **13** of the sidewall **17** shown in Figure **2**, more clearly illustrating its bilayer structure. In a preferred embodiment of the invention, the bonding interface or region **22** between the layers is formed by laminating the root-impenetrable material **16**, such as a polyethylene film, onto a porous fabric **18**.

[0041] Figure **4** is a partial perspective view of the same root-tip-trapping region **13** of the sidewall **17** shown in Figure **3** having a porous fabric **18**, such as a knit-type fabric, providing a high-density of discrete root-tip-trapping elements **28**. Plant roots **30** extend through a growth medium (not shown) to penetrate into the fabric layer **28** and root tips **34** that become trapped against the root-impenetrable layer **16**. As a result of root tips **34** becoming trapped, the root tips **34** swell somewhat, become more thick-bodied, give up control and allow side branches **31** to grow. This new root side branching occurs back approximately 4 inches from the tumescent root tip. These new side branches undergo a similar process when they become trapped in the sidewall **17**.

[0042] Figure **5** is a partial cross-sectional view of a porous fabric **18** in the air-root-pruning region **20** of the container **10** suitable for air-root-pruning. The roots **30** are allowed to extend through the fabric **18** such that the root tips **34** are exposed to the surrounding air where the root tips become dehydrated and die. Side branches **36** then grow mostly behind the material **18** and may later become air root pruned as well. It should be noted that some growth of root side branches **36** occurs within the material **18**. However, because the roots pass through the material **18**, many of these roots will be broken off when the fabric is removed. It should also be noticed that the fabric is porous and, as such, there is no barrier to water loss by either drainage or evaporation from the soil **32**.

[0043] Figure **6** is a partial cross-sectional view of the sidewall **17** in the root-tip-trapping region **13** of the container **10** (similar to Figure **3**) illustrating how the tips **34** of the roots **30** enter into the layer of porous fabric **18** and impinge upon the root-impenetrable material **16** to become trapped. As in Figure **4**, it is an important effect of the invention that the root tips **34** swell and allow enhanced root side branches **31** to grow within the growth medium **32**. Accordingly, when the plant is removed from the sidewall **17**, or a container **10** made there from, the roots **31** will not be lost. In fact, the sidewall **17** may be easily peeled away from the roots with little or no damage to the roots.

[0044] The terms "comprising," "including," and "having," as used in the claims and specification herein, shall be considered as indicating an open group that may include other elements not specified. The term "consisting essentially of," as used in the claims and specification herein, shall be considered as indicating a partially open group that may include other elements not specified, so long as those other elements do not materially alter the basic and novel characteristics of the claimed invention. The terms "a," "an," and the singular forms of words shall be taken to include the plural form of the same words, such that the terms mean that one or more of something is provided. The term "one" or "single" shall be used to indicate that one and only one of something is intended. Similarly, other specific integer values, such as "two," are used when a specific number of things is intended. The terms "preferably," "preferred," "prefer," "optionally," "may," and similar terms are used to indicate that an item, condition or step being referred to is an optional (not required) feature of the invention.

[0045] It should be understood from the foregoing description that various modifications and changes may be made in the preferred embodiments of the present invention without departing from its true spirit. It is intended that this foregoing description is for purposes of illustration only and should not be construed in a limiting sense. Only the language of the following claims should limit the scope of this invention.